Building circular in Brussels: an overview through 14 inspiring projects

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Abstract. The call for projects 'Be circular – Be Brussels' is held since 2016 and has already awarded 14 circular construction projects. On those projects, a focus is put on the better management of human and material resources. The companies in charge of the winning projects are freelances, very small businesses, SMEs and large companies. Each in its own way, applies circular measures, on site and inside its organization. Reuse, design for change and disassembly, training of workers and partnerships between companies are some of the measures implemented, which help highlight the current levers and obstacles to a circular economy in the construction sector. Many challenges still need to be addressed in order to generalize circular construction across the region, but the sector is moving and the signals it sends are positive. In particular, we notice a real transfer from investments related to the material resources (purchase of new materials and waste management) towards investments related to human resources (preliminary studies and on-site labor); this matches the regional ambition to put the human capital at the center of the work process. As practical cases, the (current and future) circular construction projects help to target the measures that should be implemented at regional and national levels, so that the circular economy becomes, indeed, the new economic model of Brussels.

Keywords: Be Circular, Brussels, material resources, human resources

1. Introduction

In order to relocate the economy to Brussels, help create employment and transform environmental objectives into economic opportunities, the Government of the Brussels-Capital Region has developed a set of 111 measures that are included in the Brussels Regional Program for a Circular Economy 2016-2020 (BRPCE). See also www.circulareconomy.brussels.

For the construction sector, identified as one of the key sectors to achieve the objectives, one of the measures that have been applied is the call for projects 'Be Circular – Be Brussels', with one category specifically dedicated to circular construction projects. The main goals of the call for projects in this category are to:

- financially and technically support contractors in their transition towards a circular economy,
- stimulate the construction sector and to demonstrate by example, so that the sector can move towards new standards,
- collect data on material flows, so that the Region can take the opportunities of economic development in hand (urban mining, recycling, new professions and training courses),
- get feedback on the difficulties experienced by the contractors, in order to lift the obstacles.

2. What is a 'Circular construction project'?

Within the call for projects 'Be Circular – Be Brussels', a circular construction project is the result of a global thought, aiming to better management of (material and human) resources. Putting people first is a central objective of the call for projects and we see, in practice, a shift from material to human resources. The skills of the teams (for instance as part of 'bouwteams') are fully used and developed, through in-depth reflection and specific know-how, relating to the topics of circular economy such as the extension of the service life of buildings, or the preservation of resources. This also allows companies to position themselves in new markets, with reference projects showing an exemplary level of quality.

2.1 Laureates

Since the first edition in 2016, 14 contractors were awarded in the category 'circular construction projects'. The selected projects have different profiles, in terms of size, type of work (renovation, extension,…), hosted functions… as shown in table 1, where projects are classified in ascending order in terms of floor surface.

Table 1. List of the 14 awarded circular projects

Project number	Project name	Main contractor	Type of work	Building type	Project size (approx.)
1	Petite Suisse	Max Stockmans	Extension	Housing	50 m²
2	Clos Dupont	Eco Construct Groupe	Extension	Housing	55m²
3	VLA	VLA-Architecture	Renovation	Offices	120 m²
4	CoPost	Max Stockmans	Renovation	Housing	135 m²
5	Warland	Global Art Concept	Renovation	Housing	150 m²
6	Dethy	Bruno Duheym	Renovation	Housing and offices	270 m²
7	Dépôt Leemans	DRTB	Extension	Housing and offices	300 m²
8	Moucherons	Florian Girault	Renovation	Housing	325 m²
9	Boondael	Ilinye Iliya	Renovation	Housing and shops	1000 m²
10	Deswaef	Gillion Construct	Renovation	Culture	1000 m²
11	Tivoli	BPC	Renovation & extension	Housing	1800 m²
12	Tour à Plomb	Jacques Delens	Renovation	Culture	3000 m²
13	Debatty	Gillion Construct	Renovation	Housing & kindergarten	5000 m²
14	Horta-ONSS	Louis De Waele	Renovation	Offices	43000 m²

The diversity in terms of project sizes is also to be found in the type of company in charge of their execution, as shown in figure 1.

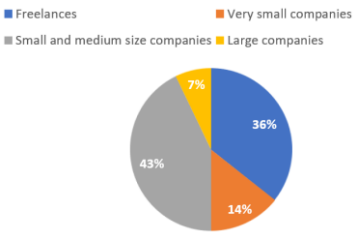

Figure 1. Types of companies in charge of the winning projects.

The companies which oversee several projects are counted several times in the figure. Most projects are carried out by SMEs (companies with between 10 and 250 employees); these projects are generally larger than 300 m². The other half of the projects is carried out by freelances and very small enterprises (companies with between 1 and 9 employees). These projects mainly concern projects smaller than 300 m². One project is carried out by a large enterprise, with more than 250 employees. This shows that the transition towards a circular approach in de building sector concerns all types of businesses, from the small freelance to the large general contractor, through the VSEs and SMEs.

2.2 Circular measures

For every project, the contractors applied circular measures, as well on site as at company level. The way they did it mainly depends on the construction projects themselves (location, type of work, expectations of the client, etc.), which creates a wide variety of results. Table 2 references the different measures that were applied related to the management of human and material resources, a short explanation of each measure and the specific projects in which the measures are applied (see table 1 for project numbering).

Table 2. Applied circular measures – Management of human and material resources

Circular measures	Details of circular measures	Projects where the measure is applied
	Management of human resources	
Integrated team management	Bringing the stakeholders together from the beginning of the project	2-5-6-7-9-11
Local workers	Focusing on the workforce coming from the Brussels-Capital Region	1-2-4-6-7-8-9-10-12-13
Training of workers	Developing the knowledge and know-how of the workers	1-2-6-7-8-9-10-12-13-14
Collaborations/partnerships	Promoting collaboration and partnerships among companies to close the loops	4-6-10-11-13-14
Social economy sector	Integrating companies with a social purpose in the process	6-11-12
	Management of material resources	
Preservation of existing buildings	Promoting renovation of buildings	All
Design for change and disassembly	Designing adaptable and reversible buildings in order to extend their lifetime and allow reuse of their components	2-3-4-6-7-8-12-13-14
Reuse	Giving a second life to construction materials	All
Management of (de)construction waste	Lowering the amount and the impact of (de)construction waste	4-6-7-8-9-11-14

It is important to emphasize here that the 'Be Circular' call for projects does not intend to impose the implementation of all the measures on each site but aims to support emerging initiatives in terms of

circularity. This explains why some winning projects concentrate their interventions on certain themes (for example, the implementation of a large quantity of reclaimed materials). Their feedback helps to identify the levers and the obstacles currently available in the Brussels-Capital Region, for some topics in particular. They also help identify the needs of the sector so that the circular approach becomes the standard approach in the constructions of tomorrow.

3. Focus on four challenging measures, their levers and their obstacles

In this paper, we chose to focus on four measures whose application appeared to be particularly innovative and challenging for the laureates on site and/or for the project design teams during the design process. Two measures are related to material resources, namely the reuse of materials and the design for change and disassembly, and two measures relate to the management of human resources, namely the training of workers and the partnerships among companies. In this paragraph, we will first shortly introduce each measure, then illustrate it through a couple of Circular construction projects and conclude by summing up the levers and obstacles that were identified during the design and building processes.

3.1 Reuse

Reuse is one of the key measures implemented in the projects. Reuse can be found in every Circular construction project, as on-site reuse, off-site reuse, by means of incoming reclaimed materials or through the attention given to the potential reuse of materials in the future.

In the 3 following projects, reuse was implemented in a different way, showing the creativity that reuse can bring in a project and on construction sites.

Figure 2. Warland - Incoming reclaimed materials: wooden flooring and marble

Figure 3. Debatty – wooden floor before and after renovation

Figure 4. Horta-ONSS – repackaging of insulation for off-site reuse.

3.1.1 Project Warland by Global Art Concept. Reuse is the basis of this renovation project of a terraced house, to transform it in a home meeting the current expectations in terms of space and acoustic performance. Reuse was done on site and via incoming reclaimed materials. Reuse avenues were studied

during the design phase by the architect, who also worked out the project according to the collected reclaimed materials (marble for the finishing of the bathrooms, teak parquet for the new flooring of the living room,...). The company in charge of the works has established its offer based on materials already collected and stored on site. In total, nearly 6 tons of reclaimed materials were used in this project.

3.1.2 Project Debatty by Gillion Construct. For the renovation of the housing buildings for the municipality of Anderlecht via a public procurement procedure, the intention was to evacuate the existing floors. It was an initiative of the main contractor to recover the 1,500 m² of existing floors, rather than to evacuate them. The parquet boards were partially dismantled to incorporate an insulation complex. They were then sanded and cleaned to live a second life on the site.

3.1.3 Project Horta-ONSS by Entreprises Louis De Waele. In this project of interior refurbishment of office spaces, the client defined from the outset an obligation of means on the part of the company to reuse a maximum amount of materials present on site. This has resulted in the off-site reuse of 400 linear meters of interior partition walls, and in the on-site reuse of techniques (heating and cooling systems, etc.), as well as false ceilings and false floors. 460 m³ of insulation in the partition walls were reused on another construction site of the company, as roof insulation. In total, more than 610 m³ of materials were recovered on site.

3.1.4 Levers and obstacles. A key factor in the successful implementation of reuse in construction projects is the sensitivity of the stakeholders to the issue of reuse. If the demand for reuse comes from the client, the application on site is clearly simplified.

The completion of a pre-demolition inventory is an essential step in a renovation. This inventory, coupled with a plan for reuse, makes it possible to frame the reuse in the project (see www.guidebatimentdurable.brussels > themes 'Economie circulaire' and 'Réemploi'), to develop the project according to the reclaimed materials, as well as to request the offers and to organize the building site accordingly (realization of dismantling tests upstream of the construction site, organization of storage, etc.). This makes it possible to avoid many obstacles (uncertainty of the construction site schedule with respect to deconstruction and re-implementation of materials, related costs, etc.).

Other levers and obstacles were pointed at the construction sites, such as the obstacles related to regulatory requirements (energy performance, safety, ..) or the tax system on reclaimed materials, which is an obstacle in some cases and a lever in others (among others via a VAT rate of 6% for materials prepared for reuse by social economy enterprises and companies for a adapted work). Membership in a network around reclaimed materials, and the possibility of working in a just-in-time manner are, in turn, pointed out as important levers.

3.2 Design for change and disassembly

The reversible and adaptable design helps extend the life and use of buildings: changes can be made during the life cycle of buildings without need for major demolitions or transformations.

3.2.1 Clos Dupont by Eco Construct Groupe. From the start of the design phase, the project was thought considering the adaptability of spaces. The extension aimed to adapt to the changing occupancy of the house and to the evolution of the family unit without major interventions or works. The lifespan of the house is thereby lengthened.

Initially, only a ground floor was present. After the works, the extension has three levels: a playground for children on the ground floor, an office space on the 1st floor, and a bedroom on the 2nd floor. The extension may be used differently in the future, for example for an independent office, a student studio, or a ground floor unit. This is possible thanks to the integration, as from design stage, of a series of measures: the extension benefits from an independent access, from its own internal vertical circulation, and from a connection to the technical installations (supply and evacuation of water). The

structural connections of the extension with the existing structure have been studied to allow the fast deconstruction of the elements in the future: only a rail is attached to the existing wall and the new joists (1st, 2nd floor and roof) come to rest on metal shoes fixed to the rail.

3.2.2 Levers and obstacles. Adaptable design requires anticipating needs, which are not always easily expressed by the client at the time of project design. It is therefore essential to ask the right questions at the beginning of the project in order to evaluate the possible scenarios and to retain the most probable ones, while remaining in an idea of reasoned adaptability to avoid unnecessary extra costs and oversizing (structure, techniques,…)

Adaptable design also requires close collaboration between the different members of the design team, as each layer of the building (structure, envelope, techniques, interior design), has a role to play in the adaptability of the building. Designing the building by dissociating the layers as much as possible, increases the level of adaptability of the building. However, communication around the adaptability of the building is essential for it to be effective. The drawing up of plans highlighting the possible use of spaces is therefore necessary. This, however, adds a significant workload for the designer, which few owners currently agree to finance.

To allow the reuse of building elements, the implementation of reversible systems is clearly a positive point. As it is the case with building adaptability, the transmission of information relating to the reversibility of building elements is essential. The transmission of deconstruction plans of the building, highlighting the steps to be taken to deconstruct the building while maintaining a maximum value of the materials deconstructed is a track to investigate. Nevertheless, it is currently difficult to find owners who are ready to finance the realization of such plans.

With this in mind, the use of BIM models opens up very interesting perspectives, allowing the integration into the digital model, of information relating to the adaptability and deconstruction of the building, as well as information relating to possible modifications during the life of the building (repairs, replacements, ...)

3.3 Training of workers

In order to optimize the management of human resources, the training of the workforce is a key issue.

The application of circular economy principles in the construction sector opens up new prospects, particularly in connection with the issue of reuse. On the circular construction sites, about half of the projects have trained workers in reuse practices (deconstruction, preparation for reuse, repackaging, effective reuse). On the other sites, reuse practices were already known by the companies; they did not require specific training but contributed to improving the knowledge and skills of companies in this area.

3.3.1 Petite Suisse, Debatty, Deswaef and Dépôt Leemans. Some projects, like Petite Suisse (by Max Stockmans), Debatty and Deswaef (by Gillion Construct) or Dépôt Leemans (by DRTB) have set up specific measures for the training of workers.

These projects supported, for several weeks, workers in training (Petite Suisse), intensively supervised trainees via a 'supervising-supervised' binomial system (Debatty, Deswaef), and proposed annual training plans, helping to retain workers and increase the quality of delivered projects (Dépôt Leemans).

These measures help improve the skills of workers in the Region and increase their attractiveness on the job market. The principles of circular economy, particularly reuse practices, allow the creation and development of jobs that are difficult to relocate, and therefore have an important role to play in the economic development of the Region.

3.3.2 Levers and obstacles. On the circular construction projects, it is noted that the integration of social clauses by the project owner in the specifications makes it possible to encourage training directly on site, by taking charge of trainees and workers in training. Despite the time and energy needed to ensure the proper care of trainees, the benefits for the company can be significant, some trainees being directly engaged by the companies in which they completed their traineeship.

3.4 Partnerships

To close the loops of the circular economy, partnerships sometimes have to be found. In the framework of the circular construction projects, several projects have developed interesting partnerships, among others linked to over-ordering and through industrial symbiosis.

Figure 5. Petite Suisse – roof insulation made with over-ordered insulation boards from Debatty project

Figure 6. Tivoli – greenhouse of Tomato Chili made of reclaimed wood and glass

Over-ordering, which is common on medium to large construction sites, creates some problems for companies. In the best case, the materials in over-order are stored for reuse on another site, but this requires some handling, immobilization of storage space, and a good follow-up of the stocks so that these materials are actually used elsewhere. In the worst case, these materials are disposed of with the construction waste, representing not only an environmental cost, but also a cost to the company that has to pay for this evacuation. If, in medium to large construction sites, the quantities available through this over-ordering are generally not very interesting for storing them while waiting for a hypothetical future use, on smaller sites, they can often correspond to the quantities precisely sought by the contractor. Partnerships between medium / large companies and small / independent companies then become very interesting.

Industrial symbiosis is another manner to close the loops. As described in the Innovation paper of BBRI [1], when an industrial symbiosis is developed, partnerships are established by a company in order to substitute one part or the totality of its raw materials coming from resource exploitation, by industrial waste coming from a partner company. In the building sector, this partnership can be developed among different companies, or among different projects within the same company.

3.4.1 Petite Suisse. The Petite Suisse project has made a collaboration based on over-ordering on the Debatty project: rigid insulation boards have been recovered from an overload of the construction site and after cuts, they have been reused in the Petite Suisse project, as flat roof insulation.

3.4.2 Horta-ONSS. The Entreprises Louis De Waele have applied the principle of industrial symbiosis on the Horta-ONSS and Logis Floréal building sites. On the first site, there was a significant amount of mineral wool insulation present in removable partition walls, that needed to be evacuated. On the other site, a need for insulating materials for 380 existing roofs. Between the two sites, an idea that seems simple: recovering the insulation of the first building site to implement it on the second. In the end, more than 486 cubic meters of insulation are extracted, reconditioned, prepared for reuse and effectively reused on the other building site. This large-scale operation was made possible in particular thanks to

the early realization of performance tests on insulation material (evaluation of thermal conductivity) by the BBRI (Belgian Building Research Institute (www.bbri.be)). These tests made it possible to validate the reuse of the extracted insulation for the intended application.

3.4.3 Tivoli. Another example of industrial symbiosis can be found on the project Tivoli (by BPC). The renovation project for the Belgacom building is part of the wider Tivoli sustainable neighbourhood project. This large-scale project will see the development of nearly 400 residential units, as well as nurseries, businesses and parks and gardens. During the construction phase, many wastes are generated, including a large volume of wood. Neighbouring the site, the company Tomato Chili develops greenhouses that can be dismantled and that are made of reclaimed materials (wood and glass). The Tivoli site is a perfect source for supplying Tomato Chili with raw material. On the side of the BPC company, this collaboration makes it possible to avoid waste disposal to recycling centers. A more detailed sorting of the wood fraction is nevertheless necessary to allow the effective reuse by Tomato Chili.

3.4.4 Levers and obstacles. In these examples, we observe that the contact among the stakeholders is the key factor for the success of the actions. Within a company, the transversal knowledge of the projects by one person can clearly help the realization of partnerships between building sites. The development of this specific function in large companies will certainly have to be pursued in the future. Among different companies, the matching of offer and demand (for materials themselves, for their quantities or even for their availability), remains difficult at present. There is a real challenge at the local level to create business-to-business networks. In the Brussels-Capital Region, the Platform of Actors for the Reuse of Building Elements (www.reemploi-construction.brussels) initiates an answer to this issue and the Werflink platform (www.werflink.com), a private-sector initiative, aims to connect companies with a view to pooling and sharing resources.

4. Conclusions

Through the 14 Circular construction projects, many themes of the circular economy are tackled, be it the circular construction or the evolution of the companies themselves towards more circularity.
In general, we notice a transfer of investments related to the material resources (purchase of new materials and waste management) to human resources (preliminary studies and on-site labor).

The feedback shows that it is already possible to implement principles of circularity on site, but that this requires, at present, some efforts on the part of stakeholders (developers, designers, contractors, suppliers, ...), as well as some creativity. Many challenges still need to be addressed in order to generalize circular construction across the region, but the sector is moving and the signals it sends are positive. Despite the obstacles pointed by the contractors, it is clear from the different editions of the call for projects, that the winning companies continue in the direction of circular construction, whether small, medium or large companies. Once the first step has been taken, companies see real opportunities (economical, environmental and societal) to work in a circular dynamic.

In order to generalize the practice, however, it will be necessary to set up additional measures to support and assist project owners, designers and companies, both at the regional and at the national level. Circular construction projects (current and future) help to target these measures, so that they are real answers to the needs of the sector and that the circular economy becomes, indeed, the new economic model of Brussels.

5. References

[1] Centre Scientifique et Technique de la Construction (CSTC), Romnée A and Vrijders J 2017 *Innovation Paper Construire circulaire – vers une économie circulaire dans la construction* p 85